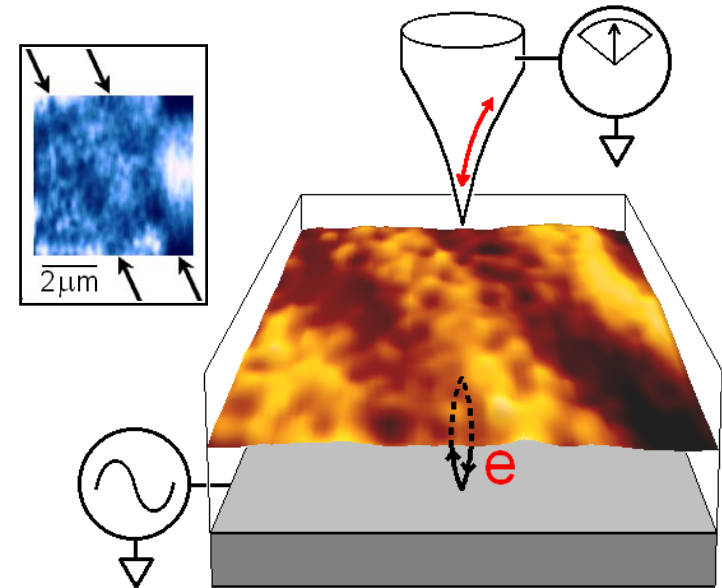


Charge Imaging Electrons in Nanoscale Systems

Stuart Tessmer, Michigan State University, DMR-0305461

Future nanoelectronic devices will require a fundamental understanding of the quantum behavior of electrons at the nanometer scale. GaAs heterostructures represent an ideal laboratory to study the quantum mechanics at play. We apply novel scanning techniques to resolve directly the structure of electrons in these systems. In the figure to the right, electrons tunnel into a two-dimensional layer from an underlying electrode. This induces image charge on a sharp metal tip, which we detect using a low-temperature transistor with a sensitivity of $0.01 \text{ electrons}/\sqrt{\text{Hz}}$.

Physical Review B, In Press, 2003.



Charge Imaging probe of stripe-like density structure in a two-dimensional electron system. We find that the application of a magnetic field can produce surprising and subtle density variations, shown as bright and dark bands. The schematic image has been Fourier processed to enhance the structure; the inset shows raw data. The data were acquired at a temperature of 270 mK.

Charge Imaging Electrons in Nanoscale Systems

Stuart Tessmer, Michigan State University, DMR-0305461

Education:

This project has provided an education in advanced surface science and scanning microscopy techniques to seven undergraduates, four graduate students, and one postdoc. These students have contributed either to the development or to the application of our novel scanning probe methods.

Outreach:

We are currently developing an educational scanning probe microscopy demonstration to be showcased in the Michigan State University Science Theatre, a project funded by this grant. The demonstration will be performed for students in grades 6-12 and will literally be a hands-on introduction to the

world of nanoscience. Undergraduate student Katie Thomas has made considerable progress designing and assembling the apparatus, as part of the NSF Research Experiences for Undergraduates (REU) program.



Katie presents the instructive components of the demonstration to fellow REU students. The inset shows the first iteration of the scanning assembly.